

IN THE CLAIMS

What is claimed is:

1. A connection for assembly of pipe, the connection comprising:
 - a first pipe having a female end;
 - 5 a second pipe having a male end;
 - said female end having an inner surface and an outer surface;
 - said male end having an inner surface and an outer surface;
 - a first plurality of protuberances circumferentially and longitudinally spaced relative to each other about the inner surface of said female end;
- 10 a second plurality of protuberances circumferentially and longitudinally spaced relative to each other about the outer surface of said male end;
 - wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on both the inner surface of said female end and the outer surface of said male end;
- 15 said plurality of circumferential arrays aligned such that said plurality of protuberances are accepted by a mating pipe end when said male and female pipe ends move longitudinally relative to each other for forming a connection; and
 - wherein the male and female ends engage upon any rotation of one pipe relative to the other pipe wherein such rotation causes said protuberances of the male end
- 20 and said protuberances of the female end to move circumferentially with respect to each other.

2. The connection according to claim 1 wherein said plurality of arrays comprises an odd number of said arrays.

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3. The connection according to claim 2 wherein an odd number of arrays provides a positive determination of a circumferential starting point for engaging the respective protuberances of the male and female ends.

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4. The connection according to claim 1 wherein said connection is used for connecting pipe, such as casing used for oil and gas exploration, which is being driven into the earth.

5. The connection according to claim 1 wherein said female end and said male end are produced at the end of separate rings, and wherein said separate rings are attached to said first pipe and said second pipe.

5 6. The connection according to claim 5 wherein said separate rings are attached by welding.

10 7. The connection according to claim 1 wherein at least some of said protuberances are shaped to be radially captured to prevent radial expansion of the female end relative to the male end.

15 8. The connection according to claim 1 wherein at least one of said protuberances embodies at least one interference dimension that causes one surface to displace a mating surface.

15 9. The connection of claim 1 wherein at least some of the protuberances have a crest and a root and wherein radial interference exists between the crest and root of at least one mating protuberance, said interference increasing with the relative rotation between the male and female ends.

20 10. The connection according to claim 1 wherein the protuberances are produced by at least one screw thread on said male end and a mating thread arrangement in said female end wherein all said threads are interrupted by slots.

25 11. The connection according to claim 10 wherein one wrap of said at least one screw thread on at least one of said first and second pipe ends is not interrupted by said slots, to provide a landing surface for said pipe ends when they are moved longitudinally into engagement.

30 12. The connection according to claim 1 wherein the arrays of protuberances have at least some lead angle wherein mating of the protuberances, of the respective female and male ends, causes further longitudinal movement and resists free rotation in

a direction opposite of the rotation direction for engagement.

13. The connection according to claim 1 wherein the arrays of protuberances have no lead angle.

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14. The connection according to claim 1 wherein the protuberances are axially pre-loaded as a result of dimensional relationships and the rotation of one pipe relative to the other pipe.

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15. The connection according to claim 1 wherein at least one protuberance in said arrays of protuberances is engagable by another protuberance to limit said rotation of one pipe relative to the other pipe.

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16. The connection according to claim 1 further comprising a first alignment indicator on said male end and a second alignment indicator on said female end wherein said indicators being positioned to correspond with the circumferential point that marks the start of an array of protuberances such that when said indicators are aligned prior to said rotation of one pipe relative to the other pipe, said indicators will provide visual indication of the amount of rotation.

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The connection according to claim 1 wherein the protuberance is substantially wedged shaped.

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18. The connection according to claim 1 wherein said circumferential arrays form an interrupted taper thread.

19. The connection according to claim 1 wherein said circumferential arrays form an interrupted straight thread.

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20. The connection according to claim 1 wherein at least one conical surface on said first pipe end is engaged and force loaded by a mating surface on said second pipe end when the connection is made up.

21. The connection according to claim 20 wherein said at least one conical surface is shaped to accept at least one seal when the connection is made up.

22. The connection according to claim 1 wherein a locking element preventing loosening extends through a wall of the female end to project into the path at least one protuberance would traverse if the connection were to loosen.

23. A connection for assembly of pipe, the connection comprising:
a first pipe having a female end;
10 a second pipe having a male end;
said female end having an inner surface and an outer surface;
said male end having an inner surface and an outer surface;
a first plurality of protuberances circumferentially and longitudinally spaced relative to each other about the inner surface of said female end;
15 a second plurality of protuberances circumferentially and longitudinally spaced relative to each other about the outer surface of said male end;
wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on both the inner surface of said female end and the outer surface of said male end;
20 said plurality of circumferential arrays aligned such that said plurality of protuberances are accepted by a mating pipe end when said male and female pipe ends move longitudinally relative to each other for forming a connection; and
wherein the male and female ends engage upon any rotation of one pipe relative to the other pipe wherein such rotation causes said protuberances of the male end and said protuberances of the female end to move circumferentially with respect to each other; and
25 at least one first abutting surface on said first pipe end arranged to oppose and mate with a second abutting surface on said second pipe end when the arrays of protuberances on the male end are substantially juxtaposed with the arrays of protuberances on the female end.

30 24. The connection according to claim 23 wherein said abutting surfaces are

on at least some of the protuberances.

25. The connection according to claim 23 wherein said at least one first abutting surface and said at least one second abutting surface are distinct from surfaces 5 of said protuberances.

26. The connection according to claim 23 wherein a piping surface extends in at least one axial direction between the axially grouped protuberances and said at least one said first abutting surface.

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27. The connection according to claim 23 wherein there are two abutting surfaces on each of said first and second pipe ends.

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28. The connection according to claim 27 wherein each of said two abutting surfaces are some axial distance from the protuberances, further wherein said protuberances are between said abutting surfaces.

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29. The connection according to claim 23 wherein said at least one second abutting surface is shaped to urge said at least one first abutting surface toward a nearest radial confining surface when said abutting surfaces experience an axially directed loading force.

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30. The connection according to claim 23 wherein said first at least one abutting surface is shaped to prevent radially directed relative movement of said at least one second abutting surface.

31. The connection of claim 23 wherein said at least one abutting surface is comprised of stab flanks on the protuberances and said second abutting surface is comprised of opposing flanks.

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32. The connection according to claim 23 wherein said plurality of arrays comprises an odd number of said arrays.

33. The connection according to claim 32 wherein an odd number of arrays provides a positive determination of a circumferential starting point for engaging the respective protuberances of the male and female ends.

5 34. The connection according to claim 23 wherein said connection is used for connecting pipe, such as casing used for oil and gas exploration, which is being driven into the earth.

10 35. The connection according to claim 23 wherein the arrays of protuberances have at least some lead angle wherein mating of the protuberances, of the respective female and male ends, causes further longitudinal movement and resists free rotation in an direction opposite of the rotation direction for engagement.

15 36. The connection according to claim 23 wherein the arrays of protuberances have no lead angle.

37. A method of making a connection comprising:
providing a first pipe having at least one female end, said female end having an inner surface and an outer surface;
20 providing a second pipe having a at least one male end, said male end having an inner surface and an outer surface;
providing a first plurality of protuberances circumferentially and longitudinally spaced relative to each other about the inner surface of said female end;
25 providing a second plurality of protuberances circumferentially and longitudinally spaced relative to each other about the outer surface of said male end;
wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on both the inner surface of said female end and the outer surface of said male end;
aligning said first pipe and said second pipe such that the female end of
30 said first pipe is aligned to receive the male end of said second pipe;
further aligning said first pipe and said second pipe wherein said plurality of circumferential arrays are aligned such that said first plurality of protuberances, are

accepted by a mating pipe end when the pipe ends move longitudinally relative to each other for forming a connection;

providing longitudinal movement wherein said male end will enter and mate with said female end;

5 continuing longitudinal movement until said male end is fully engaged in said female end; and

rotating one pipe with respect to the other pipe wherein said rotation causes the protuberances of the male and female ends to move circumferentially with respect to each other and wherein the male and female ends engage each other.

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38. The method of Claim 37, wherein the rotation of one pipe segment with respect to the other pipe segment is less than 20 degrees.

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39. The method of Claim 37, wherein said connection is used for connecting pipe, such as casing used for oil and gas exploration, which is being driven into the earth.

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40. The method of Claim 37 further comprising the steps of providing a first alignment indicator on said male end and a second alignment indicator on said female end wherein said indicators being positioned to correspond with the circumferential point that marks the start of the circumferential array of protuberances such that when said indicators are aligned prior to said rotation of one pipe relative to the other pipe, said indicators will provide visual indication of the amount of rotation.

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41. A connection for assembly of pipe, the connection comprising:
a first pipe having two ends and a second pipe having two ends;
at least one of said first pipe or said second pipe having at least one end wherein said at least one end is a drive shoe;
at least one of said first pipe or said second pipe having at least one end
30 having a female end having an inner surface and an outer surface;
at least one of said first pipe or said second pipe having at least one end having a male end having an inner and outer surface;

a first plurality of protuberances circumferentially and longitudinally spaced relative to each other about the inner surface of said female end;

a second plurality of protuberances circumferentially and longitudinally spaced relative to each other about the outer surface of said male end;

5 wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on both the inner surface of said female end and the outer surface of said male end;

10 said plurality of circumferential arrays aligned such that said plurality of protuberances are accepted by a mating pipe end when said male and female pipe ends move longitudinally relative to each other for forming a connection; and

wherein the male and female ends engage upon any rotation of one pipe relative to the other pipe wherein such rotation causes said protuberances of the male end and said protuberances of the female end to move circumferentially with respect to each other.

15 42. The connection according to claim 41 wherein said plurality of arrays comprises an odd number of said arrays.

20 43. The connection according to claim 41 wherein said connection is used for connecting pipe, such as casing used for oil and gas exploration, which is being driven into the earth.

44. A method of making a connection comprising:
providing a first pipe having two ends and a second pipe having two ends;
wherein at least one of said first pipe or said second pipe having at least 25 one end wherein said at least one end is a drive shoe;

wherein at least one of said first pipe or said second pipe having at least one end having a female end having an inner surface and an outer surface;

wherein at least one of said first pipe or said second pipe having at least one end having a male end having an inner and outer surface;

30 providing a first plurality of protuberances circumferentially and longitudinally spaced relative to each other about the inner surface of said female end;
providing a second plurality of protuberances circumferentially and

longitudinally spaced relative to each other about the outer surface of said male end;

wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on both the inner surface of said female end and the outer surface of said male end;

5 aligning said first pipe and said second pipe such that the female end is aligned to receive the male end;

further aligning said first pipe and said second pipe wherein said plurality of circumferential arrays are aligned such that said first plurality of protuberances, are accepted by a mating pipe end when the pipe ends move longitudinally relative to each 10 other for forming a connection;

providing longitudinal movement wherein said male end will enter and mate with said female end;

continuing longitudinal movement until said male end is fully engaged in said female end; and

15 rotating one pipe with respect to the other pipe wherein said rotation causes the protuberances of the male and female ends to move circumferentially with respect to each other and wherein the male and female ends engage each other; and

driving said engaged pipe segments into the ground, wherein said driving shoe enters the ground first.

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45. A coupling for assembly of pipe, the coupling comprising:

a coupling having a first end and a second end;

said first end of the coupling being a threaded male end substantially free of slots;

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said second end of the coupling being a female end having an inner and outer surface;

a first plurality of protuberances circumferentially and longitudinally spaced relative to each other about the inner surface of said female end, wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on the inner surface of said female end;

30 said plurality of circumferential arrays aligned such that said plurality of protuberances are accepted by a mating pipe end when mating male and female pipe ends

move longitudinally relative to each other for forming a connection; and

wherein the male and female ends engage upon any rotation of one pipe relative to the coupling wherein such rotation causes protuberances of the male end and protuberances of the female end to move circumferentially with respect to each other.

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46. A coupling for assembly of pipe, the coupling comprising:

a coupling having a first end and a second end;

said first end of the coupling being a threaded female end substantially free of slots;

10 said second end of the coupling being a male end having an inner and outer surface;

a first plurality of protuberances circumferentially and longitudinally spaced relative to each other about the outer surface of said male end, wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on the outer surface of said male end;

15 said plurality of circumferential arrays aligned such that said plurality of protuberances are accepted by a mating pipe end when mating male and female pipe ends move longitudinally relative to each other for forming a connection; and

20 wherein the male and female ends engage upon any rotation of one pipe relative to the coupling wherein such rotation causes protuberances of the male end and protuberances of the female end to move circumferentially with respect to each other.

47. A coupling for assembly of pipe, the coupling comprising:

a coupling having a first end and a second end;

25 said first end of the coupling being a threaded male end substantially free of slots;

said second end of the coupling being a male end having an inner and outer surface;

30 a first plurality of protuberances circumferentially and longitudinally spaced relative to each other about the outer surface of said second end of said coupling, wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on the outer surface of said second end;

5 said plurality of circumferential arrays aligned such that said plurality of protuberances are accepted by a mating pipe end when mating male and female pipe ends move longitudinally relative to each other for forming a connection; and

10 wherein the male and female ends engage upon any rotation of one pipe relative to the coupling wherein such rotation causes protuberances of the male end and protuberances of the female end to move circumferentially with respect to each other.

48. A coupling for assembly of pipe, the coupling comprising:
10 a coupling having a first end and a second end;
said first end and said second end of the coupling being a male end having an inner and outer surface;

15 a plurality of protuberances circumferentially and longitudinally spaced relative to each other about the outer surface of said male ends, wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on the outer surface of said male ends;

20 said plurality of circumferential arrays aligned such that said plurality of protuberances are accepted by a mating pipe end when mating male and female pipe ends move longitudinally relative to each other for forming a connection; and
wherein the male and female ends engage upon any rotation of one pipe relative to the coupling wherein such rotation causes protuberances of the male end and protuberances of the female end to move circumferentially with respect to each other.

49. A coupling for assembly of pipe, the coupling comprising:
25 a coupling having a first end and a second end;
said first end of the coupling being a threaded female end substantially free of slots;
said second end of the coupling being a female end having an inner and outer surface;
30 a first plurality of protuberances circumferentially and longitudinally spaced relative to each other about the inner surface of said second end of said coupling, wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on the inner surface of said second end;

5 said plurality of circumferential arrays aligned such that said plurality of protuberances are accepted by a mating pipe end when mating male and female pipe ends move longitudinally relative to each other for forming a connection; and

10 wherein the male and female ends engage upon any rotation of one pipe relative to the coupling wherein such rotation causes protuberances of the male end and protuberances of the female end to move circumferentially with respect to each other.

50. A coupling for assembly of pipe, the coupling comprising:
10 a coupling having a first end and a second end;
said first end and said second end of the coupling being female ends having an inner surface and an outer surface;

15 a plurality of protuberances circumferentially and longitudinally spaced relative to each other about the inner surface of said female ends, wherein said circumferential spacing forms a circumferential array comprising at least one longitudinal column on the inner surface of said female ends;

20 said plurality of circumferential arrays aligned such that said plurality of protuberances are accepted by a mating pipe end when mating male and female pipe ends move longitudinally relative to each other for forming a connection; and
wherein the male and female ends engage upon any rotation of one pipe relative to the coupling wherein such rotation causes protuberances of the male end and protuberances of the female end to move circumferentially with respect to each other.

51. A threaded connection for end-to-end assembly of pipe sections to pipe
25 strings, the connection comprising:

20 a first pipe end with a socket and a second pipe end with a pin to mate with said socket;
30 a plurality of first cam patches of first arcuate cams extending peripherally about the inner surface of said socket, said first cam patches separated by surfaces defining peripherally extending first slots;

a plurality of second cam patches of second arcuate cams extending peripherally about the outer surface of said pin, said second cam patches separated by

surfaces defining peripherally extending second slots;

all said slots and patches arranged such that said patches are accepted by said slots when said pin end is axially inserted into said socket;

5 all said arcuate cams axially distributed some distance and comprising lands and grooves peripherally extending some distance in a selected helical direction, said grooves configured to accept said lands when rotation of said box relative to said pin causes said lands to move peripherally along said grooves; and

10 at least one first abutting surface on said first pipe arranged to oppose and mate with a second abutting surface on said second pipe, with a selected axial force, when said patches on said pin are approximately juxtaposed with said patches on said socket.

52. The connection according to claim 51 wherein said abutting surfaces are on at least some of said arcuate cams.

15 53. The connection according to claim 51 wherein said at least one first abutting surface and said at least one second abutting surface are distinct from surfaces of said arcuate cams.

20 54. The connection according to claim 51 wherein a tubular surface extends in at least one axial direction between said cam patches and said at least one said first abutting surface.

55. The connection according to claim 51 wherein there are two said at least one abutting surfaces on each of said first and second pipe ends.

25 56. The connection according to claim 55 wherein each of said two abutting surfaces are some axial distance from said patches, said patches between said abutting surfaces.

30 57. The connection according to claim 51 wherein at least some of said lands and their related said grooves are shaped to radially capture said lands within its related said grooves to prevent radial expansion of said socket relative to said pin.

58. The connection according to claim 51 wherein said at least one second abutting surface is shaped to urge said at least one first abutting surface toward a nearest radial confining surface when said abutting surfaces experience an axially directed loading force.

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59. The connection according to claim 51 wherein said first at least one abutting surface is shaped to prevent radially directed relative movement of said at least one second abutting surface.

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60. The connection according to claim 51 wherein at least one of said arcuate cams embodies at least one interference dimension that causes one surface to displace a mating surface, by material strain, to increase the torque required to rotate said first pipe relative to said second pipe.

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61. The connection according to claim 51 wherein said cams are produced by at least one screw thread on said pin and a mating thread arrangement in said socket, wherein all said threads are interrupted by said slots to produce said arcuate cams.

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62. The connection according to claim 61 wherein one wrap of said at least one screw thread on at least one of said first and second pipe ends is not interrupted by said slots, to provide a landing surface for said pipe ends when they are moved axially into engagement.

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63. The connection according to claim 51 wherein at least one conical surface on said first pipe end is engaged and force loaded by a mating surface on said second pipe end when the connection is made up.

64. The connection according to claim 63 wherein said at least one conical surface is shaped to accept at least one ring seal when the connection is made up.

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65. The connection according to claim 51 wherein at least some of said lands and grooves have dimensional relationships such that an interference resists rotation of

said socket relative to said pin, said interference requiring expansion of said socket for the connection to be completed.

66. The connection according to claim 51 wherein all arcuate cams are made
5 from at least one thread, said thread to begin with a minimum axial dimension and expand uniformly and continually throughout the thread peripheral dimension, the grooves receiving said thread axially dimensioned to fully engage both flanks of the thread when connection make-up is complete.

10 67. The connection according to claim 51 wherein a locking element extends through a wall of the socket to project into the path at least one arcuate cam would traverse if the connection were to loosen, to prevent such loosening.

15 68. The threaded connection of claim 51 wherein said at least one abutting surface is comprised of stab flanks on said first cam patches and said second abutting surface is comprised of opposing flanks.

69. A threaded connection for end-to-end assembly of pipe sections, the connection comprising:

20 first and second pipe ends to be threadedly joined, said first pipe having female configuration defined as a box, the second pipe having mating male configurations defined as a pin;

the box having, in series, a first abutment surface defining one end of the first pipe, a first unthreaded length, a first threaded length, a second unthreaded length, 25 and a second abutment surface to terminate the box configuration on the first pipe;

the pin having, in series, a third abutment surface to mate said second abutment surface, a third unthreaded length to be received in the second unthreaded length, a second threaded length to mate with the first threaded length, a fourth unthreaded length to be received in the first unthreaded length, and a fourth abutment 30 surface to mate with the first abutment surface and terminate the pin configuration;

the first and second threaded lengths, each, comprising at least two patches of incomplete threads on the pin and similar and mating patches of incomplete threads

in the box, all said patches formed by peripheral thread cut-outs producing surfaces to define slots which will accept the patches when the box receives the pin in axial relative movement, the patches on the pin arranged to engage the patches in the box when the pin is rotated relative to the box, said abutting surfaces to be axially force loaded a 5 preselected amount when the patches on the pin are approximately juxtaposed with the patches on the box.

70. The threaded connection of claim 69 wherein radial interference exists between the crest and root of at least one mating thread, said interference increasing, 10 within selected limits, with the relative tightening rotation between the pin and the box.

71. The threaded connection of claim 70 wherein said interference increases until a selected amount of relative rotation of the box and pin is achieved, then said interference is reduced for the remaining amount of the tightening relative rotation.

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72. The threaded connection of claim 69 further comprising a first and second conical surface, wherein the first and the second conical surfaces open toward the end of the pin.

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73. The threaded connection of claim 69 wherein said thread and its receiving groove are tapered such that, when the patches are juxtaposed, each uninterrupted length of thread fully fills at least the axial dimension of the receiving thread groove.

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